mounted device, head-mounted device, and/or other wearable device, or in other configurations.

[0061] As shown in the example of FIG. **14**, asymmetric drive signals may change orientation. For example, signals **118** may be used to create a sensation of applied force in a first direction whereas signals **120** (in which the positions of the steep and less steep portions of the waveform have been reversed) may create a sensation of applied force in an opposing second direction. As indicated by dashed lines **122**, the peaks of sawtooth drive signals may, if desired, be truncated. FIG. **15** shows how drive signal I may have a sawtooth shape embedded in sawtooth envelope **122**. FIG. **16** shows how Gaussian drive signal pulses may be embedded within sawtooth envelope **122**. In the FIG. **17** arrangement, drive signal I has an overall sawtooth shape upon which smaller increasing sawtooth features have been impressed. Sawtooth pulses **124** of drive signal I of FIG. **18** have steep rising edges, which is in opposition to the overall slowly rising and rapidly falling sawtooth envelope **122** of signal I. Other drive signals may be used in controlling haptic output components **80** if desired. The arrangements of FIGS. **14**, **15**, **16** **17**, and **18** are merely illustrative.

[0062] FIG. **19** is a diagram showing how a user may use device **10** to supply a system with user input to manipulate a displayed object such as object **154**. A user may grip device **10** so that the user's fingers receive haptic output from output components **80** (and, if desired, provide input to overlapping sensors **94**). A motion sensor in device **10** may gather motion input as a user moves device **10**.

[0063] During operation of the system, object **154** may be presented to a user visually (e.g., using a display in a head-mounted device such as device **100** of FIG. **1** or other display and other optional electronic equipment such as an associated set-up box, computer, etc.). The user may use force input, touch input, motion input, voice input, and/or other user input gathered with device **10** to control the system. For example, a user may point device **10** in direction **150** at object **154** and may press on a button, touch sensor, force sensor, or other component or may otherwise indicate to device **10** that the user has selected object **154** to enable user manipulation of the position of object **154**. Once object **154** has been selected, the use may move device **10** in direction **152** so that a motion sensor in device **10** can sense a desired movement of object **154** in direction **156**. Motion input from device **10** can then be used by the system to move the displayed object. If desired, user input for moving object **154** may also be provided using touch input, force input, and/or other input.

[0064] When the user moves object **154** in direction **156**, object **154** may come into contact (visually) with another object being displayed for the user such as object **158**. As the leading surface **160** of object **154** comes into visual alignment with surface **160** of object **158**, control circuitry in the system may direct haptic output components **80** to provide directional output that gives rise to a sensation of resistance to further movement of device **10**. In this way, virtual boundaries may be rendered and other sensations of force can be created in association with the visual content being presented to the user (e.g., when a virtual object interacts with other virtual items). The directional haptic feedback being provided to a user in the example of FIG. **19** may be oriented in direction **164** and may be applied when surface **162** meets surface **160** to make it appear to the user as if object **154** has struck object **158** in the real world. This type of force feedback may be provided to the user in any suitable operating environment (e.g., when viewing virtual reality content and/or mixed reality content using head-mounted device, when working in a content creation or productivity application on a desktop computer, when playing a game on a television using a set-top box, when dragging displayed objects across a cellular telephone display, etc.). The use of haptic output components **80** in device **10** to render resistance to virtual object movement in a virtual reality world being presented to a user with a head-mounted display or other device **100** that communicates with device **10** is merely illustrative.

[0065] The foregoing is merely illustrative and various modifications can be made to the described embodiments. The foregoing embodiments may be implemented individually or in any combination.

What is claimed is:

1. An electronic device, comprising:

a housing having a surface;

a sensor configured to receive a user input;

a haptic output component in the housing configured to provide haptic feedback to a user's body part, wherein the haptic output component includes actuators extending along a length of the surface and configured to move back and forth in a given direction parallel to the length;

control circuitry in the housing, wherein the control circuitry is configured to drive the haptic output component with an asymmetric signal to produce an apparent applied force in the given direction to the user's body part based on the user input; and

wireless communications circuitry in the housing, wherein the wireless communications circuitry is configured to transmit a signal based on the user input.

2. The electronic device defined in claim **1**, further comprising:

a display, wherein the display is on an additional surface of the device that extends from the surface at a non-zero angle.

3. The electronic device defined in claim **1**, wherein the housing has four sidewalls running around a periphery of the housing, and wherein the surface is on one of the four sidewalls.

4. The electronic device defined in claim **3**, further comprising:

a display having four edges, wherein each of the four edges is aligned with a respective one of the sidewalls.

5. The electronic device defined in claim **1**, wherein the actuators each comprise a stack of electrodes and interposed layers of adjustable material that expand and contract along the length in response to signals applied to the layers with the electrodes.

6. The electronic device defined in claim **1**, wherein the housing comprises a head-mounted housing.

7. The electronic device defined in claim **2**, wherein the housing comprises a finger mounted housing and the haptic output component provides haptic feedback to a user's finger.

8. The electronic device defined in claim **7**, wherein the finger mounted housing has a U shape that exposes a user's finger pad.

9. The electronic device defined in claim **7**, wherein the finger mounted housing has a ring shape.